# Hard Edge Simulation of TETRA Ring in GEANT (again)

Steve Kahn

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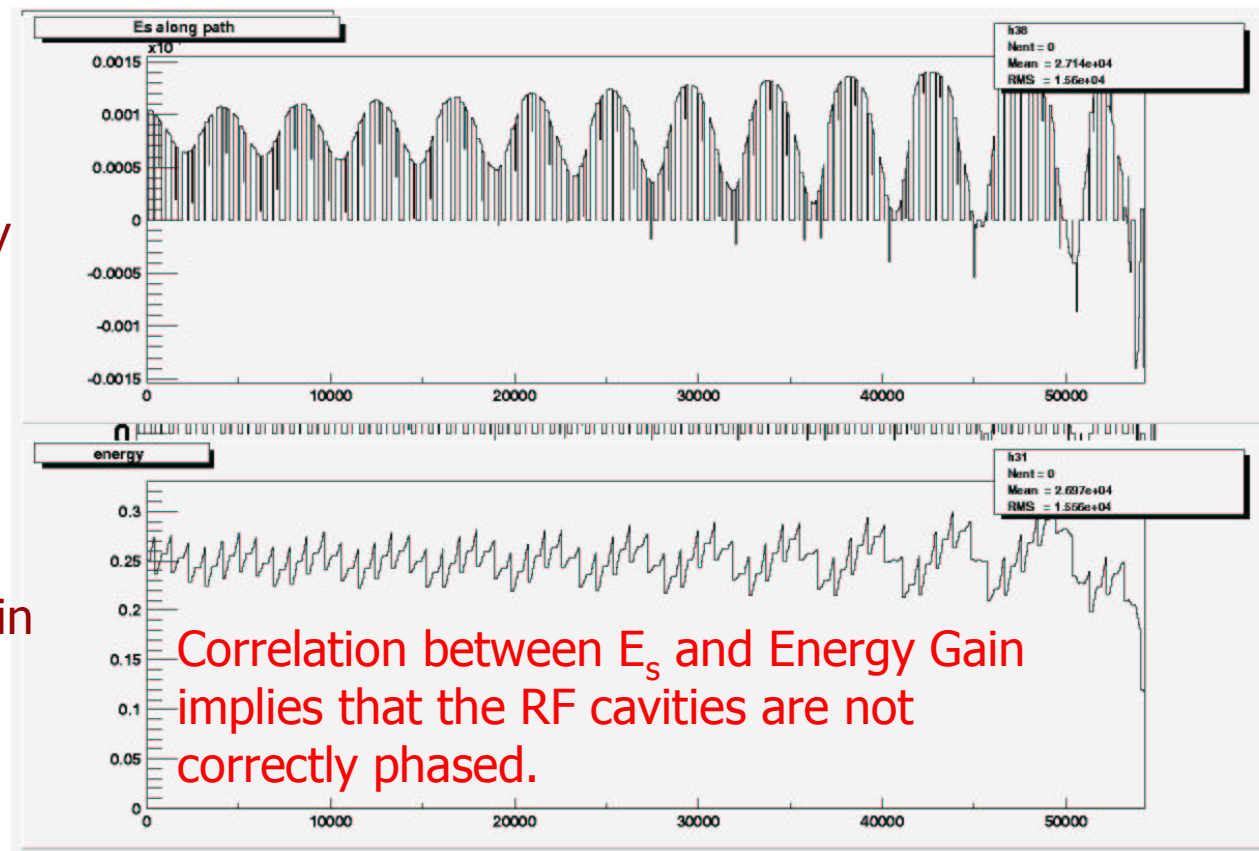# Why No Progress With Realistic Fields

- Need to Understand the GEANT with Hardedge Fields before Attempting Realistic Fields.
    - My attempts (and others) have reported large losses in using GEANT with this simulation.
- Valeri Balbekov has shown that one can achieve a reasonable amount of cooling with reasonably good transmission through this TETRA ring.
    - Rick Fernow has similarly achieved similarly good results with a high FoM for the TETRA ring in ICOOL.
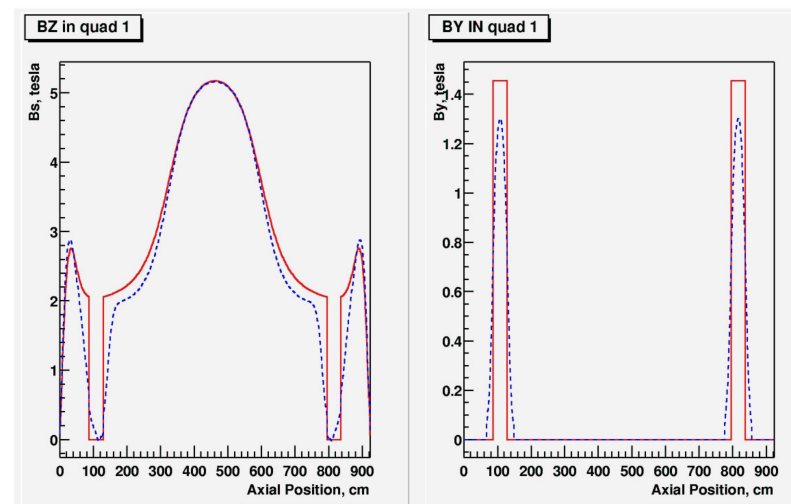
- Field maps of the solenoids have been supplied to Makino and Berz for use in their COSY model.

Concern whether RF is Properly Phased

E_s at cavity center

Energy Gain

Correlation between E_s and Energy Gain implies that the RF cavities are not correctly phased.

Reference Track to Phase RF Cavities

- Figure shows a reference muon circulating in the ring for 20 turns.
    - Reference track is launched on axis with ideal P_μ and no P_T.
    - RF cavities are active.
    - Absorbers are present.
        - dE/dx is turned on but no random processes are.
    - Track shows very little deviation from axis (shown on next transparency).
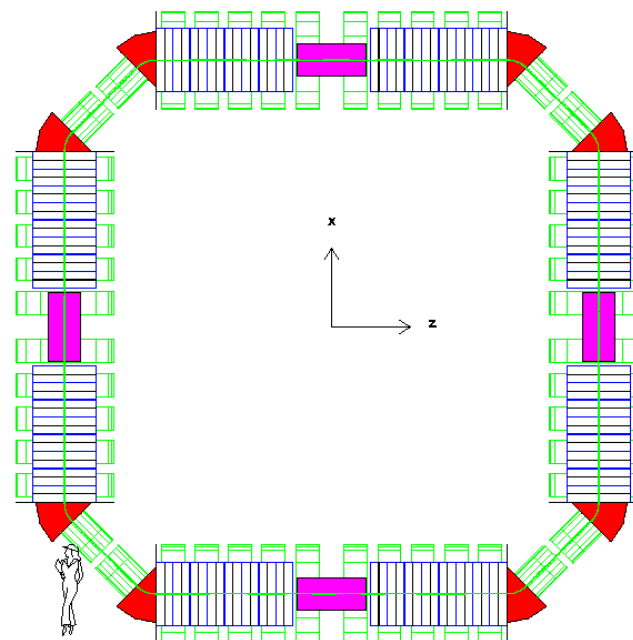
Phasing the RF — Looking at Path Time

- The top figure shows the path time that the reference particle traverses one quadrant.
  - Only the gradient is varied.
  - RED line indicates what is expected from frequency.
- The lower figure shows the RMS variation of the path time for
  - Cavity 1 in the four quadrants of turn 1.
  - The quadrant path time for all cavities in turn 1.
- These figures indicate that the correct gradient is ~15.1 MV/m.
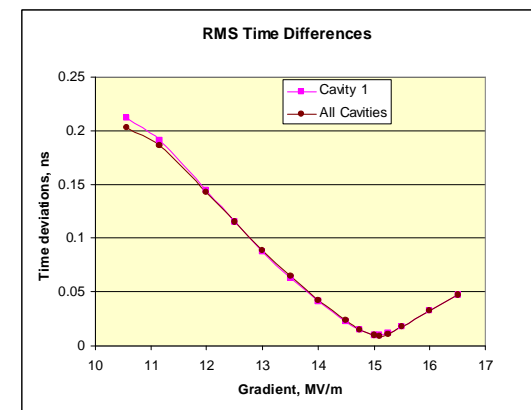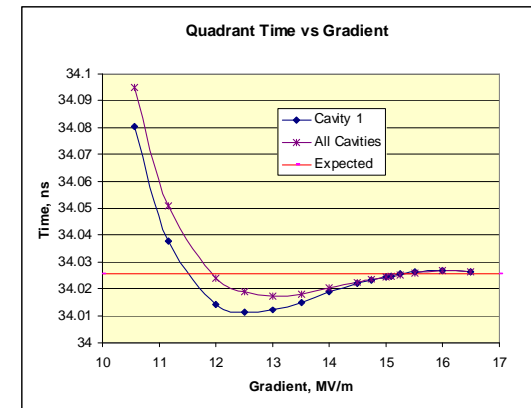
Phasing the RF — Looking at Energy Gain

- The top figure shows the mean difference in energy gain between corresponding cavities in adjacent quadrants for the 1st turn.

  - Ideally this difference should be zero. All cavities in all should have the same energy gain difference.

- The lower figure shows the RMS variation of the energy gain differences between corresponding cavities in adjacent quadrants.

- Both figures also imply that the ideal gradient should be ~15.1 MV/m.

Energy Gain vs Gradient

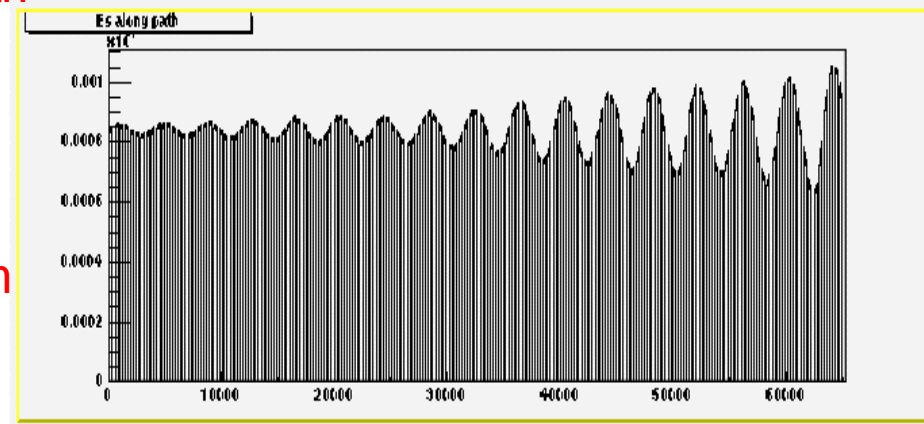**Energy Gain vs. Gradient**
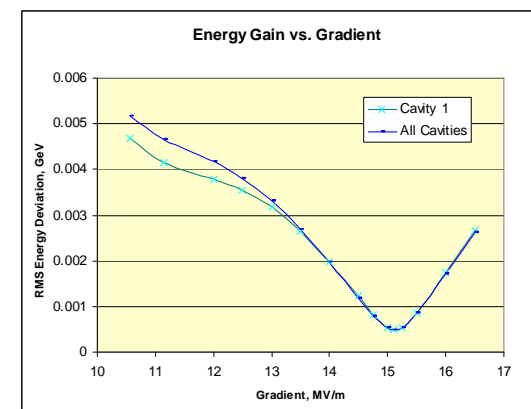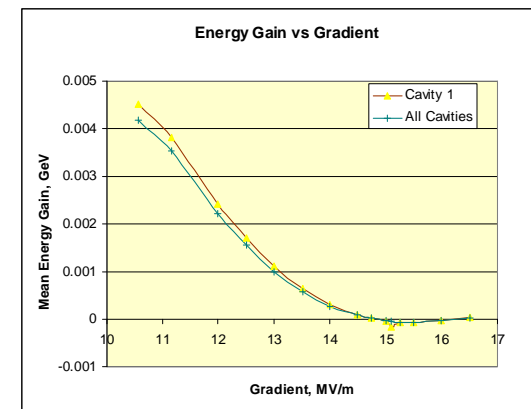
Using the Optimized Gradient

- The reference particle sees a more stable E_s and energy variation along its path at least during the early turns.
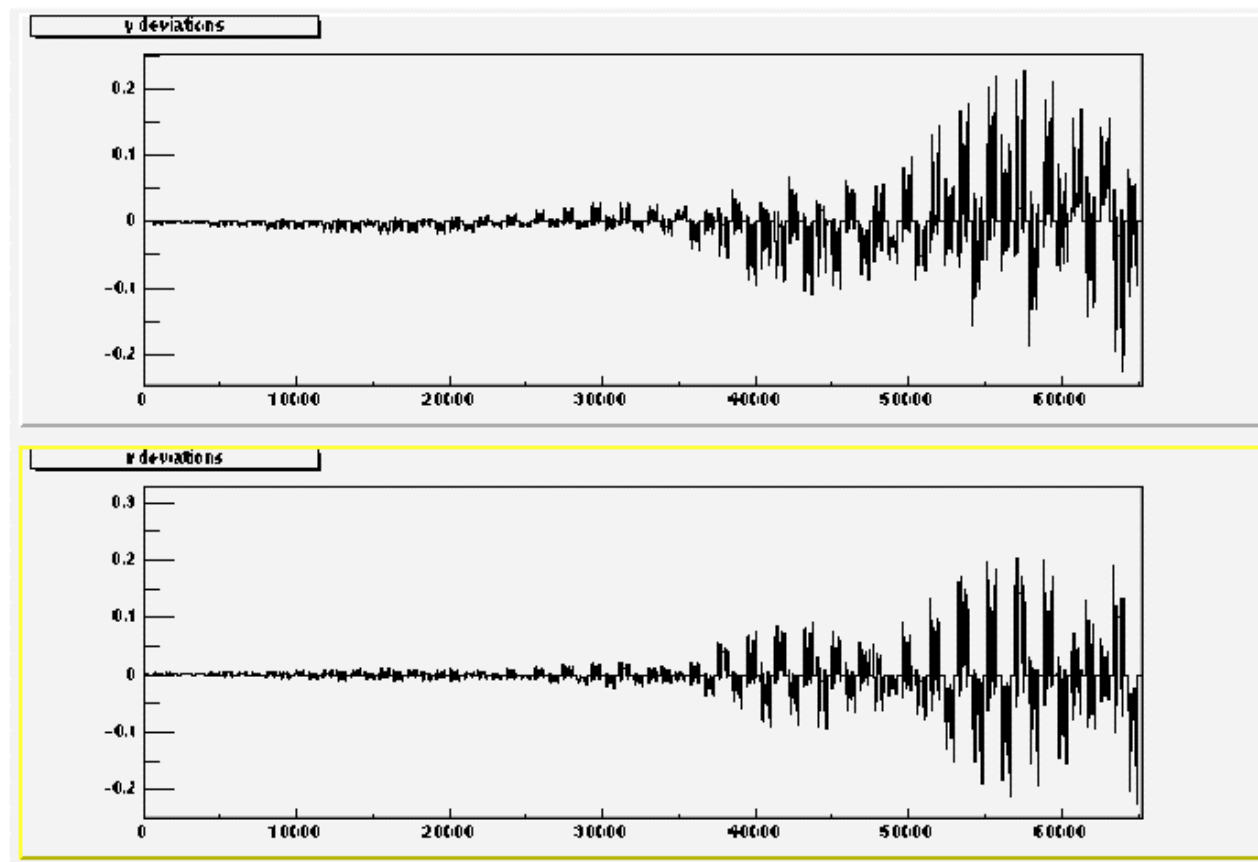
  Energy along Reference Path
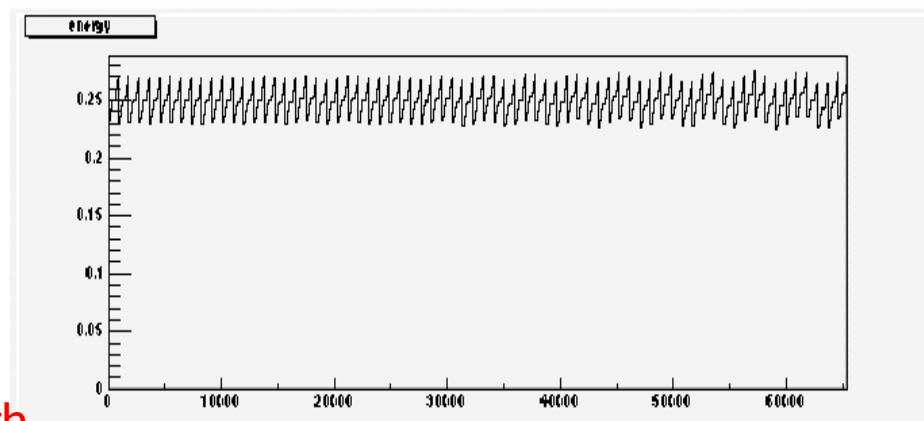
- There is still room for improvement.

  E_s along Reference Path

# Deviations of Reference Particle from Ideal Orbit

Typical Run

- **Figure shows 20 particles passed through ring with RF on and wedges in place:**
    - $\sigma_x = \sigma_y = $ 4 cm, $\sigma_{ct} = 8$ cm
    - $\sigma_{PT} = 32$ MeV/c, $\sigma_E = 18$ MeV
    - Correlation between E, P_T, B
    - No decays
    - No random processes
        - dE/dx is mean value
- **Figure illustrates losses that typically occur in corner regions.**

ARTE   RING COOLER-NEW SCHEME FROM BALBEKOV   19/10/02
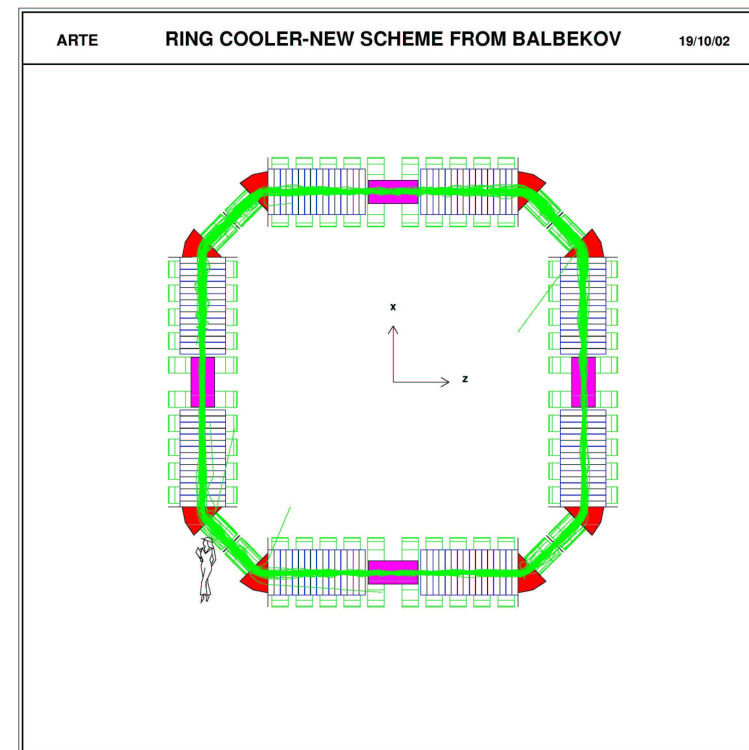
Emittance Calculations

- The figure shows the transmission, transverse emittance. (Ignore the 6D emittance, there is a problem with it).

  - The transmission drops to ~10% in 12 turns.
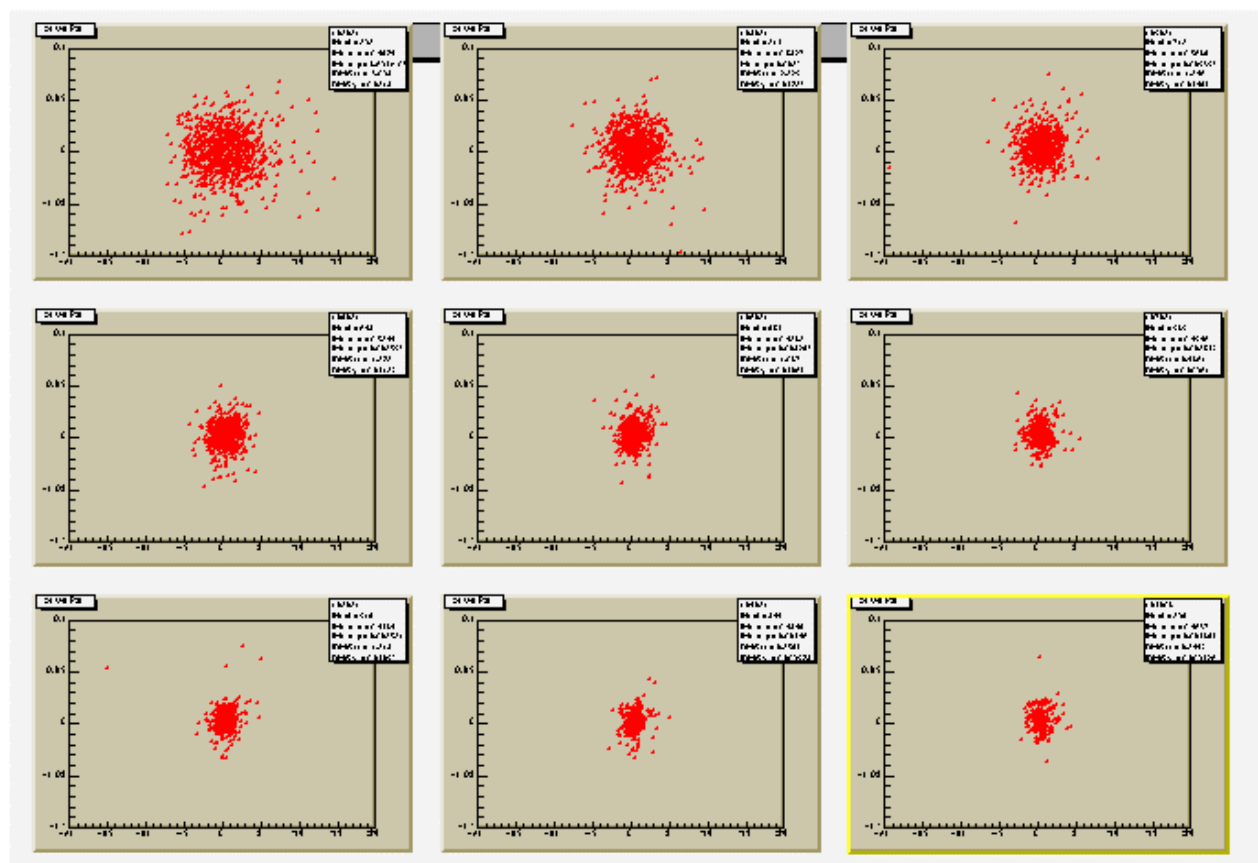 - Emittance drops significantly but that is due to losses more than cooling.
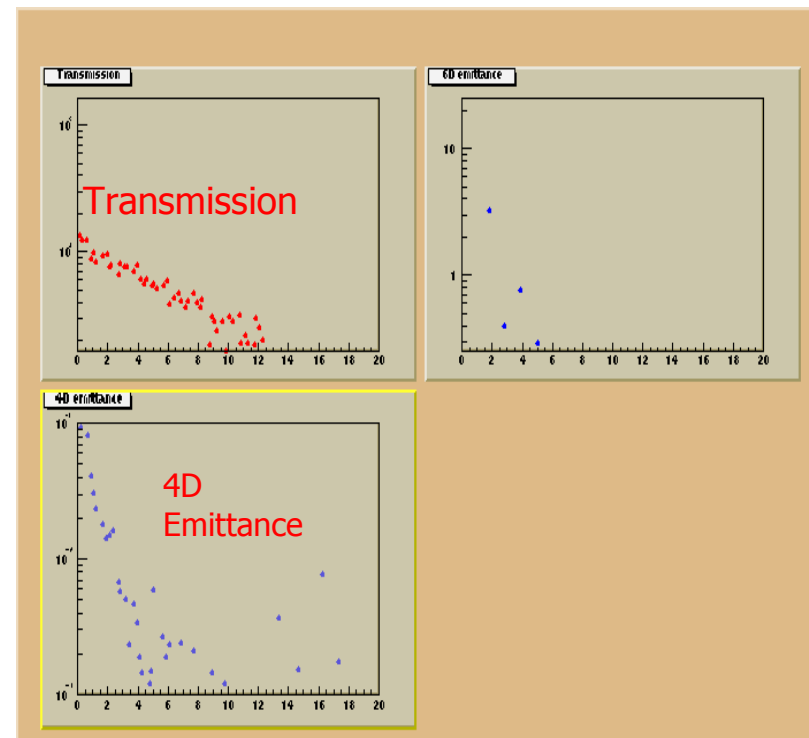
Dispersion Plots

- The figure shows the dispersion along the straight solenoid.
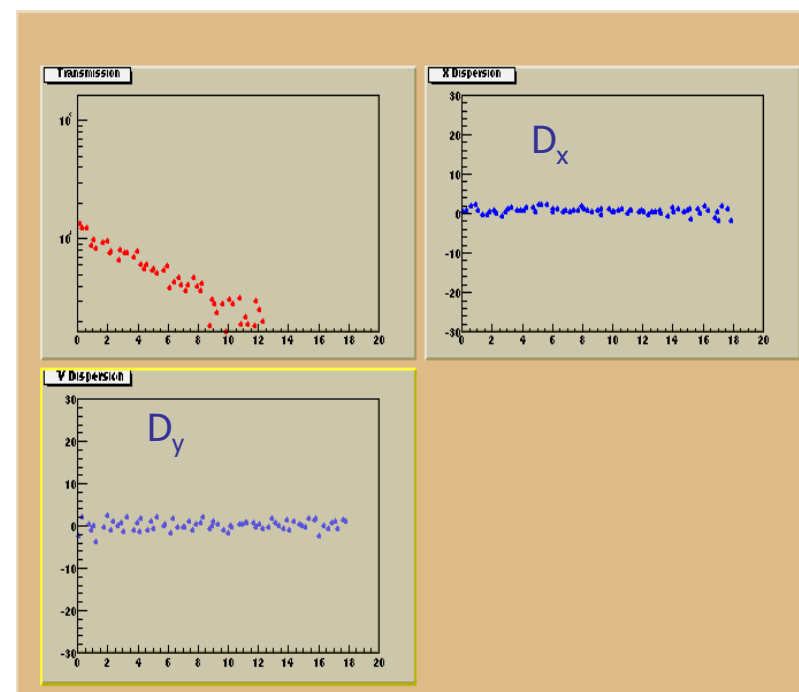
Transverse Phase Space Plots

P$_x$ vs x at same position for 1st nine turns

Longitudinal Phase Plot

E vs. ct at same position for 1st nine turns